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LAST BUT NOT LEAST

“She’s a waterfall”: Motion aftereffect and perceptual design in video games involving virtual musicianship

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Abstract. A particularly unpleasant version of motion aftereffect was revealed after extensively playing proprietary video games in which the task is to co-ordinate spatially distributed responses in time with music. During playing, key musical and rhythmic phrases descend as coloured shapes from the top of the screen. After playing, static text is presented that appears to slide upwards, reflecting a neural reaction contrary to the falling shapes. The game both serves as a contemporary example of motion aftereffect and also highlights certain cross-modal associations between space, time, and sound in the design of stimulus-response relations.

The scene may be a familiar one: you are sitting in a small room devoid of natural sunlight watching a visual display. Before you is a complex response pad. The task has been explained to you over a series of practice trials, but now you have to begin in earnest, still unsure of your perceptual and motor abilities. Not only is this the way many researchers spend much of their working life, it is also the way some are spending their recreational time. Salient examples of the blur between psychophysical test and video game are the increasingly popular gaming experiences that offer the promise of virtual musicianship such as *RockBand* and *Guitar Hero*. For those unfamiliar with the task demands, it is relatively easy to find online videos of annoying talented individuals successfully completing Metallica’s “Battery” on expert mode. In such games, key musical and rhythmic phases descend in the form of coloured shapes on multiple columns organised left-to-right, which must be intercepted at the correct time by using spatially compatible and semantically congruent response units such as guitars and drums. What becomes nauseatingly apparent is the following. After attempting to complete a song, in which the player is exposed to this visual stimulation anywhere between a few seconds (if they are particularly bad) and 6 or 7 minutes (if they are particularly good and also enjoy playing the prog-rock selections on offer), the game displays text relating to performance as the next song is loaded. The weary gamer will note with some displeasure that the text appears to be creep up the screen in a contemporary example of motion aftereffect, thought to reflect differences in the ratio of firing between specific direction-sensitive cells (see Mather et al 2007, for a recent review incorporating neuroimaging work). Further informal observations suggest that the magnitude of the effect is larger as a result of a particularly successful bout of synchronised ‘shredding’. This is consistent with the modulation of the motion aftereffect as a result of individual differences in selective attention (Chaudhuri 1990; Huk et al 2001), which may in this example be confounded with a reduction in eye movement at the time of adaptation.

Also apparent is how the ease of fixation during playing is facilitated by the design of the stimulus–response relationships within the game. First, when drumming, there is clear spatial stimulus–response compatibility (Simon and Wolf 1963) between the columns down which the rhythmic phrases descend and the horizontal arrangement of the drum pads. Second, when playing either guitar or bass, this is also true, with the

additional distribution of pitch in broad accordance with historical spatial stereotypes [recently rediscovered as the SMARC (Spatial-Musical Association of Response Codes) effect—Rusconi et al 2005] in which low notes are positioned leftward of high notes. Third, colour is also implemented as a redundant dimension (Garner 1974) along which response categorisation may occur. For example, the green shapes might only fall down the leftmost column whilst the orange shapes might only fall down the rightmost column. Whilst dark and light colours do interact with other auditory and visual dimensions (Marks 1987), it is currently not clear whether the particular colour order selected in these games maps onto any universally preferred ‘weak synaesthetic’ (Martino and Marks 2001) pattern. Fourth, in terms of the spatial representation of time, the mapping is semantically congruent, in that future events are higher up in terms of elevation and further away in terms of distance (Tufte 2001). As the time to respond approaches, the shapes move towards the virtual musician increasing in size and moving down the screen. As a consequence of this, the stimuli take on a looming (as opposed to receding) quality, a feature of both visual and auditory sensation thought to be of significant survival value and enhanced perceptual sensitivity (eg Maier et al 2004).

On the basis of these observations, a number of additional ‘experiments’ suggest themselves. Particularly interesting is the use of left–right relations to represent pitch changes of differing magnitude within the game. Speed and accuracy to small pitch changes may be compared to large pitch changes represented by the same spatial distance in order to extract more detailed information relating to pitch scaling along the azimuth. It is also possible to speculate whether there is an asymmetry in the magnitude of motion aftereffect for psychophysically equated looming and receding signals under the current presentation conditions (after Scott et al 1966). No firm predictions regarding the outcome of these studies are made, although extensive piloting is anticipated. One final consideration should be the contribution of individual differences to the magnitude of motion aftereffects, to which the only current advice can be: “keep on rockin’”.

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